THE TIOGA GROUP

Project 99-130:
Goods Movement Truck and Rail Study
Executive Summary

Prepared for:
Southern California Association of Governments

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THE TIOGA GROUP

CAMBRIDGE SYSTEMATICS INC

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Goods Movement Truck and Rail Study
Executive Summary

Overall Findings and Implications

Surface freight transportation via truck and rail will be vital to the SCAG region under any current or future scenario. The efficiency of freight transportation affects the prospects for regional job creation and the strength of the local economy. The trucking industry is facing difficult times in Southern California and elsewhere. Congestion, costs, and periodic driver shortages are all increasing. Diversion of truckload and LTL traffic to rail carload, transload, or intermodal service is a logical step to promote long-term efficiency and minimize congestion and emissions.

- Increased carload rail service would reduce congestion and emissions, but has practical access and logistics limits.
- Truck-rail transloading has significant potential to increase the use of rail carload service for line-haul freight transportation and decrease truck VMT and emissions on regional highways. Due to the need for local pick up and delivery, however, transloading may not reduce the number of local/urban truck trips.
- Intermodal transportation likewise has significant potential to mitigate emissions and congestion on major interregional access routes. The intermodal industry has already been successful in serving the long-haul markets to and from the SCAG region, and there may be limits to further marker penetration. Again, the need for local/urban pick up and delivery trips would remain.
- The regional rail network has reserve capacity at present, but there are limits on the ability of the rail network to expand service, including the competing needs of passenger rail systems. Railroads will be reluctant to devote scarce capacity and capital to shorter-haul traffic.

Diversion of truck traffic to rail, therefore, would be a positive step but not a panacea.

Where the potential for traffic and emissions mitigation is constrained by rail capacity, a case can be made for public sector support.

- Truck diversion potential is greatest in “short-haul” rail corridors.
- The largest volume of inter-regional truck trips are under 500 miles, which is “short-haul,” low-revenue traffic for the railroads.

The largest potential diversions of SCAG region truck traffic are in the I-5 corridor, where short-haul rail carload/transload and intermodal traffic has difficulty competing due to geography. Although the railroads recognize the potential and have taken the initiative to market their services in the I-5 corridor, market penetration has been small.

Both intermodal and transloading services require investment in facilities.

- Existing intermodal facilities are nearing capacity, and their expansion potential at existing sites is limited.
- Transloading facilities are primarily private concerns, although their development has been supported by the railroads to some extent.

Public capital or operating support may be required to realize the potential for short-haul truck diversions.

- Railroads cannot be expected to devote scarce line and terminal capacity to short-haul opportunities without adequate returns.
- The public benefits of additions to rail line and terminal capacity may be justified by the potential for truck traffic diversions.

Purpose

Freight transportation is a major U.S. and worldwide industry. Worldwide, industrialized and developing nations depend on efficient freight transportation for internal distribution of goods and for growing trade with the rest of the world. Efficient freight transportation is critical to a healthy regional economy.

- Freight transportation typically accounts for 12-15% of the value of finished products.
- Manufacturers and other shippers rely on efficient freight transportation to obtain raw materials and to compete in distant markets.
- Wholesalers, retailers, and other receivers need efficient freight transportation to obtain and distribute goods economically, on time, and in good condition.

The propose of this study was to provide SCAG with a broad understanding of surface freight transportation in the region.

- Determine the potential for movement of freight by train.
- Determine whether truck or rail infrastructure and operational improvements will influence future rail and truck volumes.
- Examine the potential for shorter range freight movements.
- Establish the energy and environmental impacts within the region for trains and trucks.
- Provide guidance to policy makers on investments in truck and rail facilities.

This study is focused on truck, rail, and intermodal freight transportation.

- Truck and rail the inland surface modes that carry the vast majority of freight of concern to the general public.
- Intermodal, in this study, includes rail/truck movements and the rail and truck portions of marine/rail/truck movements.
- Air carriers primarily handle high-priority, lightweight, or very valuable freight in express or air cargo service, and are not analyzed.
- Pipelines handle liquid commodities in bulk, mostly petroleum and petroleum products, and are also not analyzed.
- Marine carriers handle waterborne shipments, and are only mentioned in connection with rail and truck modes.

Background

There is no single public source of consolidated, detailed freight data across multiple modes. The project team acquired and complied the following sources.

- 1999 Carload Waybill Sample (rail)
- 1997 Commodity Flow Survey (all modes)
- 2000 (base year) SCAG Heavy Duty Truck Model

These data sources do not match in the details of methodology, coverage, definitions, or classification. The analysis conducted for this project is intended, therefore, to inform and support broad policy decisions rather than to examine individual freight flows.

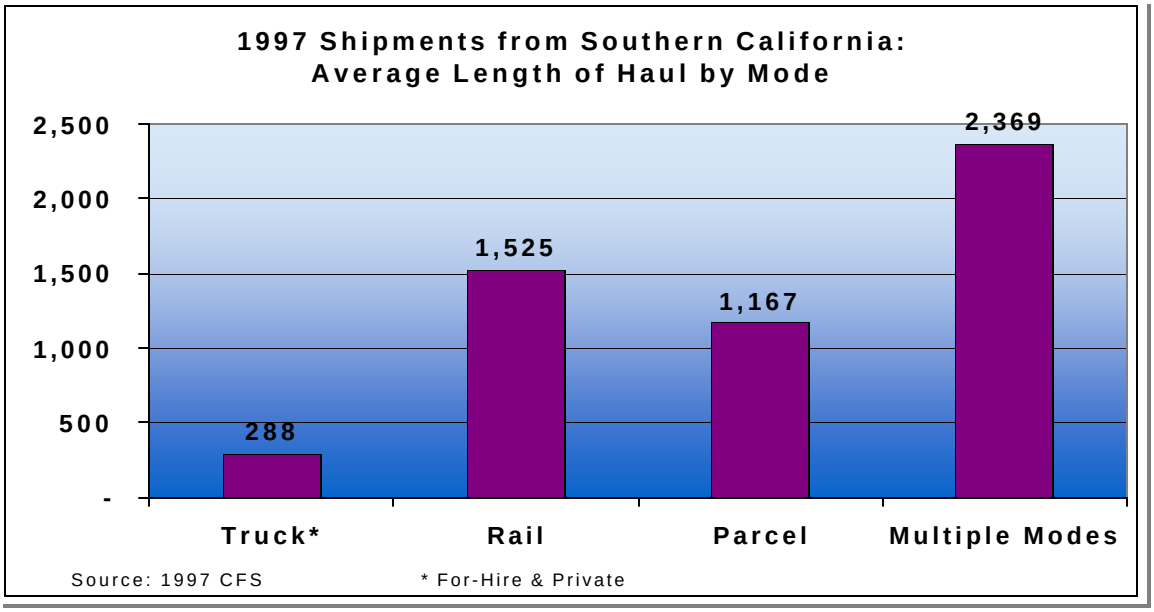
The data showed that intercity freight transportation is overwhelmingly regional in character.

- 80% of the tonnage originating in Southern California stays within the SCAG region.
- 90% of the tonnage originating in Southern California stays within the state.
- 77% of the tonnage received in Southern California comes from within the SCAG region.
- 83% of the tonnage received in Southern California comes from within the state.

Length of haul (Exhibit 1) differs noticeably by mode.

- Trucking is a regional and local business, with a short average length of haul. Over 75% of the truck tonnage moves less than 50 miles.
- Rail and intermodal are primarily long-haul modes, although rail movements include both short and long hauls.

Exhibit 1: Average Length of Haul by Mode

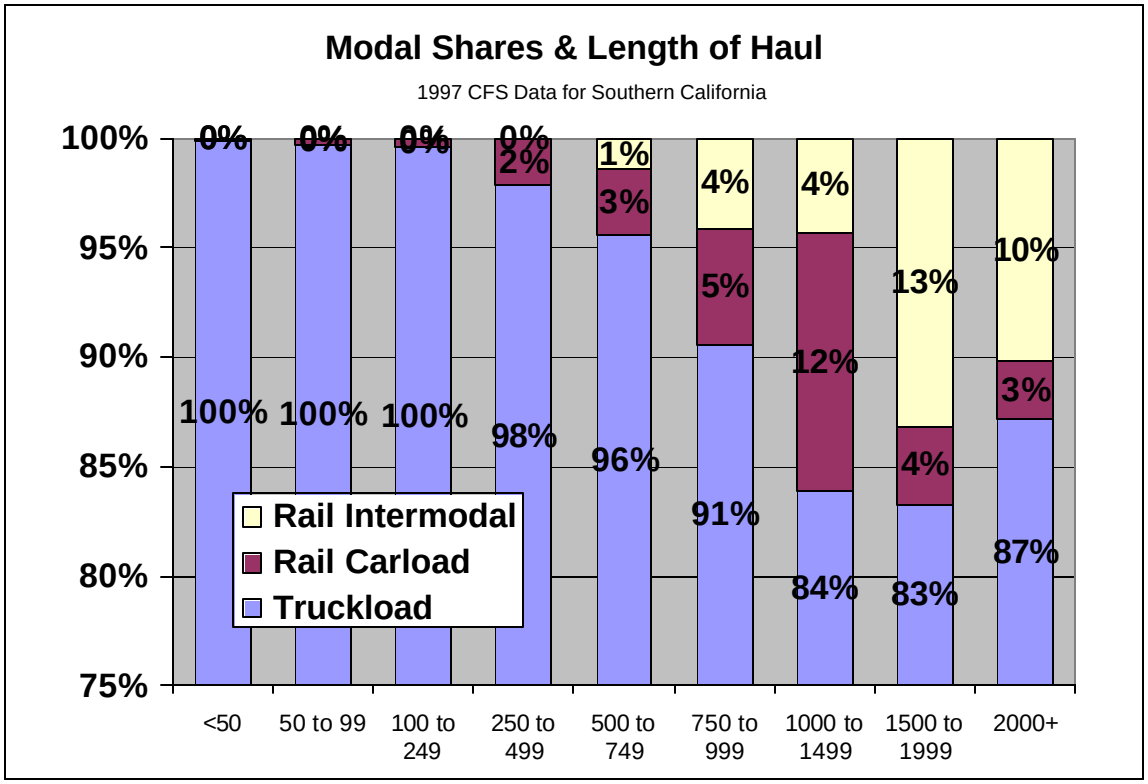


Truck Transportation

Truckload carriage dominates SCAG regional freight transportation (Exhibit 2). Trucking is the default mode, and truck ton-miles are growing faster than other modes. From the customer's viewpoint, truck is the default mode due to:

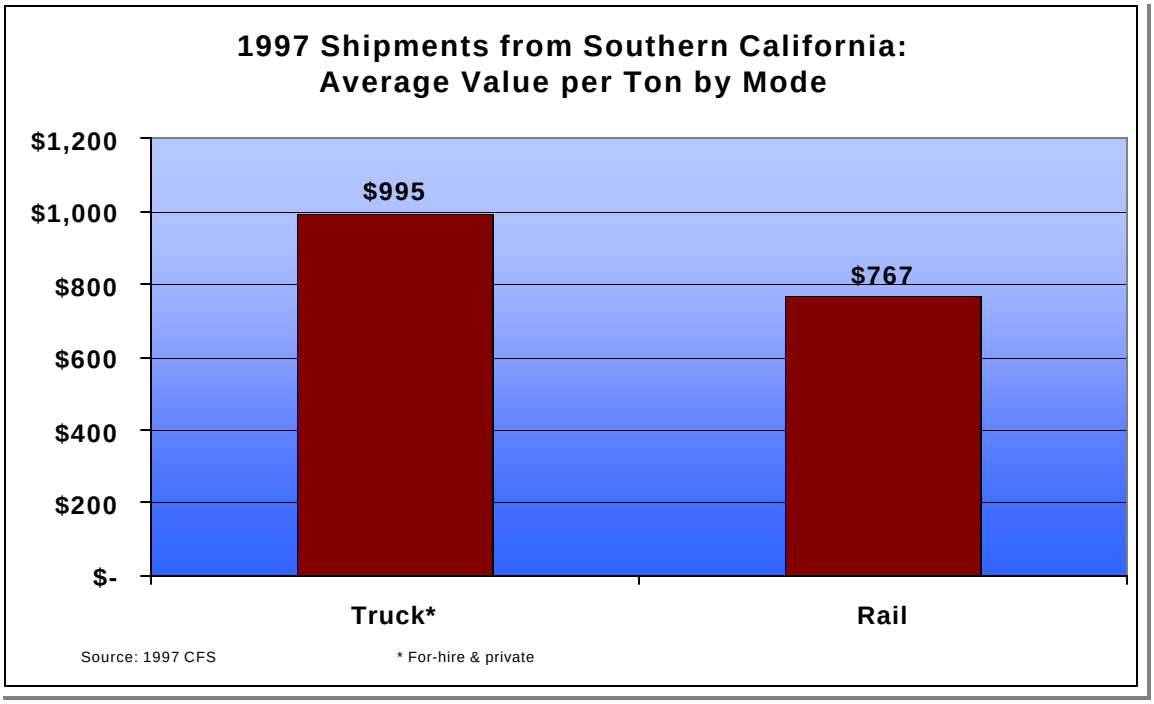
- pre-bundled truck delivery in terms of sale;
- lack of knowledge regarding complex alternatives;
- risk seen in alternatives; and
- shortage of management time and resources to explore choices.

Exhibit 2: Modal Shares and Length of Haul



Trucks carry the higher-value freight, as shown in Exhibit 3.

Exhibit 3: Average Value by Mode



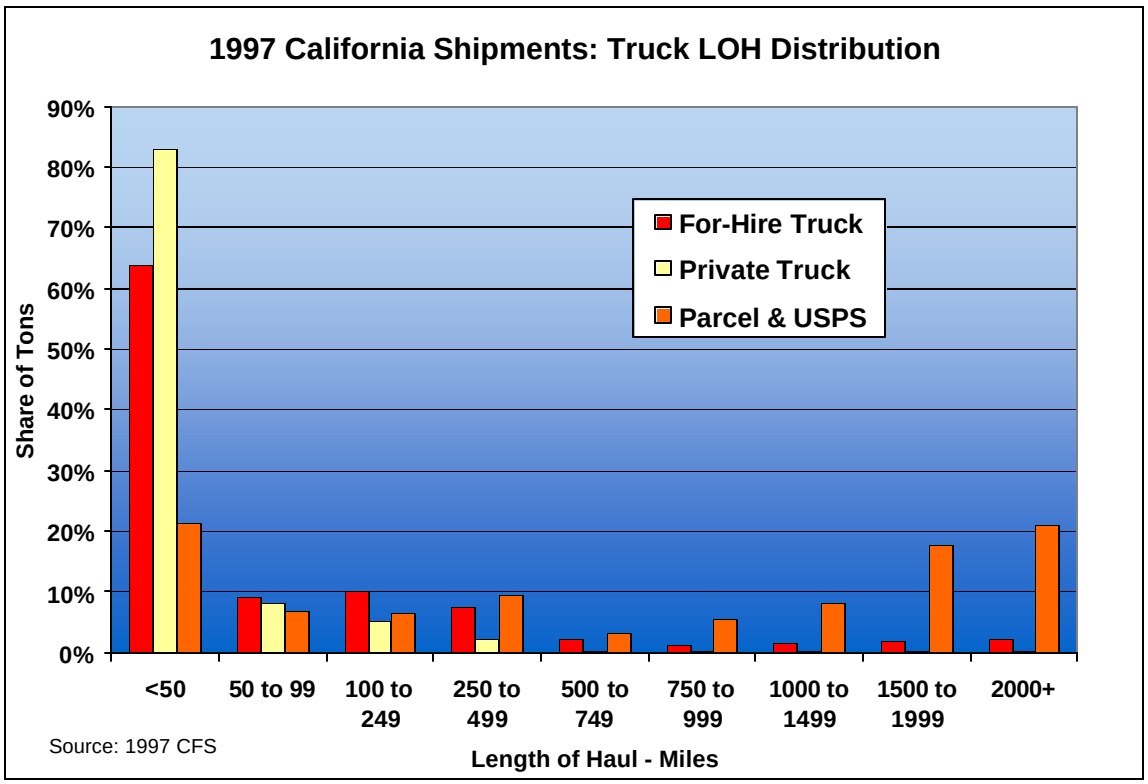
Over-the-road (OTR) trucking includes two major kinds of service relevant to this study.

- **Truckload service (TL)** – For-hire or private units moving as a single shipment directly between origin shipper and consignee.

- **Less-Than-Truckload service (LTL) and Parcel Service** – Long-haul trucks moving multiple shipments between terminals with local pickup and delivery by smaller trucks.

Most heavy-duty trucks are in private fleets engaged in truckload service for the fleet owner. As Exhibit 4 shows, most trucks serve local and short-haul markets.

Exhibit 4: Truck Segment Length of Haul



Regional Trucking Trends

The trucking industry is facing difficult times in Southern California and elsewhere.

- A pervasive driver shortage is affecting every segment of the trucking industry. Wages, training costs, and recruitment expenses are all rising.

- Insurance is a hidden cost in trucking, but it is also rising. A serious side issue is that rising insurance costs tempt marginal firms to skimp on coverage or let it lapse.

- Fuel prices have come down a bit in recent months but are still uncomfortably high.

Against this background of rising costs customers continue to demand better, faster, and cheaper service.

Environmental restrictions also have an impact on trucking.

- Stricter current and future environmental standards in Southern California and the state as a whole raise trucking costs compared to other regions.

- "Clean" diesel fuel is more costly; truckers avoid filling up their tanks in California.

- Older, less costly equipment is less likely to pass inspection in California.

- Stricter emissions standards may eventually require truckers to operate separate equipment in California, complicating operations.

The most pervasive trend in Southern California truck transportation is the impact of congestion.

- **Congestion affects operations and cost**. Congestion adversely affects average speed, reliability, and predictability of truck service. By forcing trucking firms and their drivers to take more time for the same transportation service, congestion cuts productivity and raises costs. In slower stop-and-go operations trucks are less efficient and incur higher fuel and maintenance costs for the same trip length. By lengthening delivery times and diminishing reliability, congestion hurts trucking service quality.

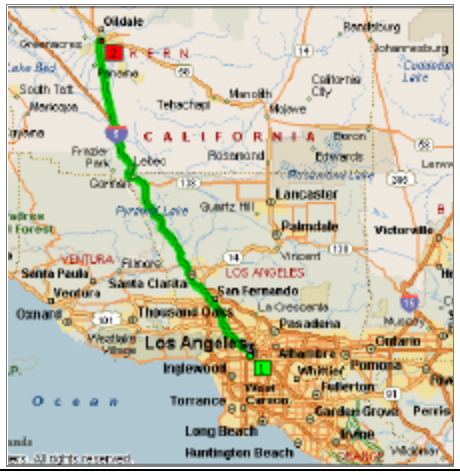
- **Congestion adversely affects truck drivers.** Long-haul drivers are paid by the mile, and congestion reduces their earning potential. Intermodal drayage drivers (owner-operators) are paid by the trip, so slower speeds reduce their daily earning potential as well. Congestion and its adverse impacts exacerbate the truck driver shortage. Freight movement growth and longer trips times due to congestion require more truck drivers at the same time the population pool of eligible drivers is shrinking and better employment options are growing.

- **Congestion exacerbates environmental problems.** Congestion increases fuel use and emissions at the same time diesel trucks are being held to more stringent emissions standards and fuel prices are increasing.

The four examples below show representative regional trucking movements and illustrate the impact of congestion and delay. Current costs were estimated at $1.12 per mile. The study team then developed estimates of driving time and cost under significantly increased highway

congestion. Note that the cost per mile increases as speed drops to keep driver earnings at an acceptable level. For illustrative purposes, congestion-related costs were estimated at $1.55 per mile.

Exhibit 5: LA– Bakersfield Trip Impacts



LA to Bakersfield
Driving distance: 111.6 miles
Total travel time: 2 hours, 18 minutes
Driving time: 2 hours, 18 minutes
Cost: $124.99

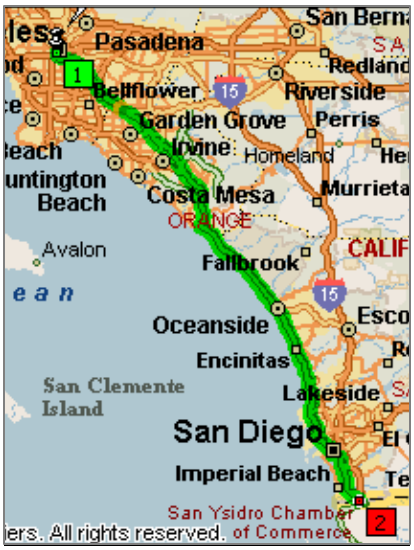
LA to Bakersfield
Driving distance: 111.6 miles
Base travel time: 2 hours, 18 minutes
New travel time: 4 hours, 36 minutes
Base Cost: $124.99; **New Cost $172.98**

Exhibit 6: LA – Phoenix Trip Impacts

LA to Phoenix
Driving distance: 372.9 miles
Total travel time: 7 hours, 12 minutes
Driving time: 7 hours, 12 minutes
Cost: $417.67

LA to Phoenix
Driving distance: 372.9 miles
Base travel time: 7+ hours
New travel time: 14 hours, 30 minutes
Base Cost:$417.67; **New Cost $578.02**

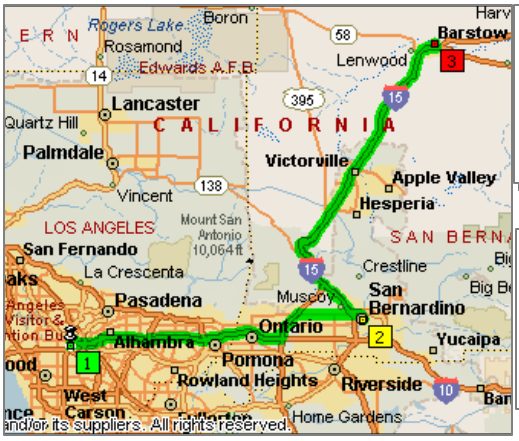
Exhibit 7: LA – Border Trip Impacts



LA to Border
Driving distance: 136.2 miles
Total travel time: 2 hours, 57 minutes
Driving time: 2 hours, 57 minutes
Cost: $152.52

LA to Border
Driving distance: 136.2 miles
Base travel time: 2 hours, 57 minutes
New travel time: 6 hours
Base Cost: $152.52; **New Cost $211.07**

Exhibit 8: LA – Barstow Trip Impacts



LA to Barstow
Driving distance: 133.7 miles
Total travel time: 3 hours, 4 minutes
Driving time: 3 hours, 4 minutes
Cost: $149.79

LA to Barstow
Driving distance: 133.7 miles
Base travel time: 3 hours, 4 minutes
New travel time: 6 hours
Base Cost: $149.79; **New Cost $207.30**

Existing plans and programs would not make appreciable improvements in trucking conditions.

- Major regional truck routes are approaching capacity limits and will require substantial investments to keep trucks and autos moving at acceptable service levels.
- The overall feasibility, cost, and performance of exclusive truck lanes is still open to question, as analysis has only been completed only one route (SR-60).

The vast majority of goods-related investments and improvements contemplated in the 2002 SCAG Regional Transportation Improvement Plan are aimed at railroad grade crossings or conventional highway and street improvements that benefit autos as well as trucks.

Rail Transportation

Rail freight transportation options include carload service, transloading, and intermodal service. Customers receive service via a company rail siding or must have access to a rail transfer facility such as an intermodal terminal or a bulk transload site.

Rail Network Overview

The regional rail network has reserve capacity for traffic that might be diverted from the highway.

- The major main lines serving the SCAG region are high-capacity routes with reserve capacity, although prioritization will be necessary.
- When traffic has grown, railroads have typically invested in higher capacity to handle it.
- Railroads ordinarily give priority to long-haul traffic with higher revenue potential over shorter-haul traffic with lower yield

There are, however, competing uses for that capacity.

- The growth of the Southern California economy and the portions of that economy engaged in large-scale manufacturing and processing imply a long-term need for rail carload service.
- The existing Southern California domestic intermodal market is growing, with concomitant demands for both capacity and service.
- The largest single engine of intermodal growth is international trade though the San Pedro Bay ports, which could absorb most or all of the existing excess rail system capacity.

Major Routes

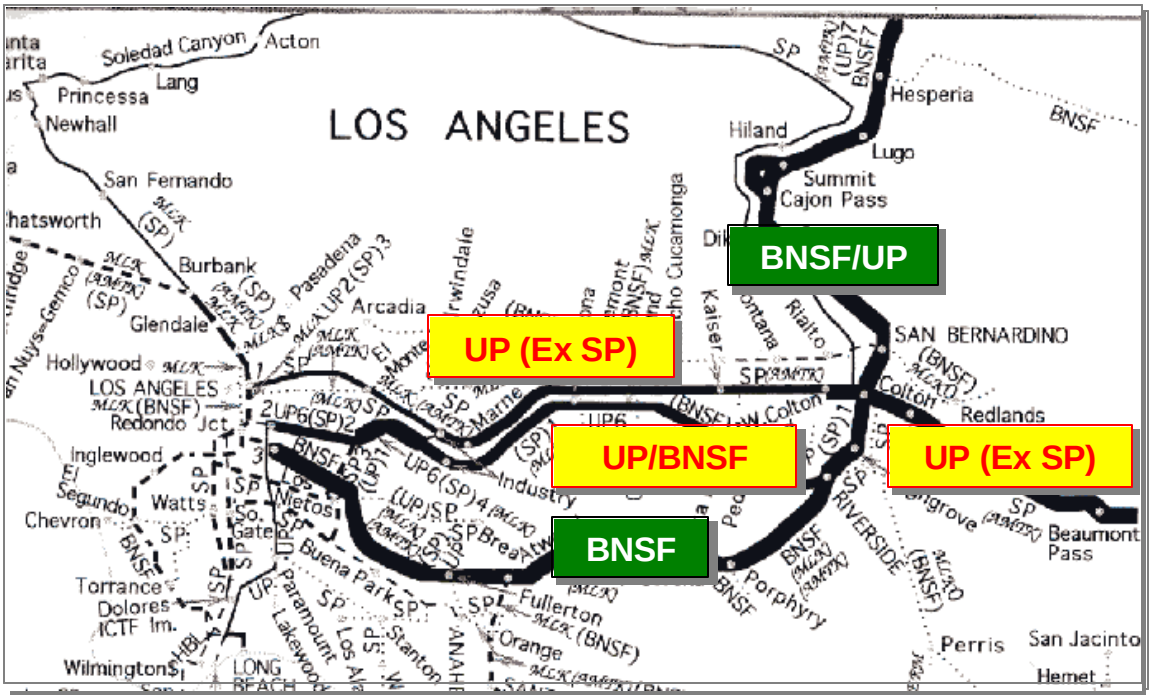
The major routes run generally eastward from Los Angeles, including the ports, to the San Bernardino area. There are five rail corridors connecting the SCAG region with the rest of the nation.

- UP's Coast Line north through Ventura County to the Bay Area (former SP route).
- UP's Saugus Line via Burbank and Palmdale, connecting with UP's Central Valley lines at Mojave (former SP route).

- UP's Palmdale Cutoff between Palmdale and West Colton, allowing UP's long-distance traffic to bypass the Los Angeles Basin (former SP route).
- UP's mainline from Los Angeles via Colton and Beaumont Pass to Yuma and points east (former SP route).
- BNSF's line through Cajon Pass to Barstow and points east (former ATSF route), which also carries UP's traffic via trackage rights.

A few major main lines carry most of the traffic, as shown in Exhibit 9.

Exhibit 9: Major Rail Routes



Source: U.S. Railroad Traffic Atlas, Ladd Publications, 1997

There are four short lines active in the SCAG Region.

- **Pacific Harbor Line**, a subsidiary of Anacostia and Pacific, which handles the switching and dispatch into and out of the Ports of Long Beach and Los Angeles.
- **Los Angeles Junction Railway**, a subsidiary of the BNSF and managed as part of the BNSF system, which provides switching services in the Vernon area for both BNSF and UP.
- **Ventura County Railroad**, owned by Rail American Inc., which switches Port Hueneme and provides a short line connection to the UP.
- **The San Jacinto Branch Line**, a BNSF-operated line connecting industries between Riverside and Hemet to the BNSF and controlled by Riverside County.

These railroads perform specific local functions, and connect with the trunk-line railroads for movements to and from the SCAG region. In essence, they serve as feeder lines.

There are numerous industrial switching operations serving individual plants. As these do not provide common carrier freight transportation, they are not covered by this study.

Passenger Rail Conflicts

The SCAG region is also served by Amtrak and Metrolink, providing intercity and commuter rail passenger service, respectively. Amtrak uses the lines of the major railroads, and Los Angeles Union Passenger Terminal. Metrolink primarily uses a network of local lines purchased from the freight railroads, with other routes shared.

- The greatly expanded scope of regional rail passenger service limits the "windows" available for additional freight service.
- Recent, rapid expansion of regional rail passenger service has pre-empted use of existing branch lines and main lines.
- The combination of frequent stops and high running speeds for regional passenger service is not compatible with efficient, high capacity freight operations or industrial access.

Railroad Line Capacity

The major factors in railroad line capacity are the following.

- **Number of tracks.** Double track generally allows trains to pass in opposite directions without stopping.
- **Number and length of sidings.** Longer sidings on single or multiple track lines allow for longer trains and increase the likelihood that trains can avoid stopping when meeting or passing other trains.
- **Number of crossovers and other connections.** Crossovers allow trains to use other tracks but also force trains to slow down.
- **Type of signaling.** Centralized Traffic Control is generally expected to yield the highest capacity but is not justified on low-volume routes. There are many types and variations of signaling systems.
- **Speed limits.** Speed limits are determined both by track and route conditions and by the environment, including the presence of grade crossings, passenger stations, etc. Maintaining track standards for higher speeds is costly, and must be justified by capacity increase and traffic demand.
- **Grade and curvature.** To overcome steeper grades and tighter curves, trains require more power at any given tonnage and speed. As trains must slow down

around tight curves or when descending steep grades, the number of trains that can pass through in a given time declines.

- **Traffic mix.** Higher speed intermodal traffic will yield more trains, but lower speed unit trains of bulk commodities will yield more tonnage.

Railroad line and terminal capacity is not an exact science.

- Different "rules of thumb" result in different capacity estimates.
- Resourceful, dedicated managers can often operate their facilities at volumes beyond their estimated capacities.
- Poorly designed or indifferently managed facilities will become congested before their estimated capacity is reached.
- There is no simple measure of capacity, since railroad traffic is a mix of commodities and train types moving with different speeds and priorities.

There are no public data on the present or expected usage and performance of the private rail system. The growth in international intermodal traffic will be the major source of pressure on rail infrastructure, capacity, and operations. It is generally believed that the expected growth in rail intermodal service, primarily due to the projections for increased imports at the Ports of Los Angeles and Long Beach, will fill the existing capacity of both railroads within the LA Basin sometime before 2025.

Rail Geography

Geography imposes some serious limitations on the ability of the rail network to expand service.

- Rail lines use mountain passes with steep grades and limited right-of-way.
- Steep grades and tight curves reduce speeds, limit train lengths, and increase costs.
- Narrow right-of-way shared with highways makes it difficult and costly for railroads to increase capacity.

The railroads have invested in capacity improvements, but are constrained by the geography. Between the SCAG Region and the rest of North America are a series of mountain passes that constrain railroad capacity and performance.

- The UP (former SP) Coast Line has steep grades at Cuesta, near San Luis Obispo.
- The UP and BNSF lines through the Inland Empire pass through Cajon Pass.
- The UP line to the southeast passes over Beaumont Hill.

The Alameda Corridor is a major infrastructure project involving consolidation of rail to and from the Ports of Long Beach and Los Angeles onto a 20-mile, high-capacity, grade-separated right of way following Southern Pacific's former Alameda line. From the rail perspective, the Alameda Corridor project will have three basic impacts:

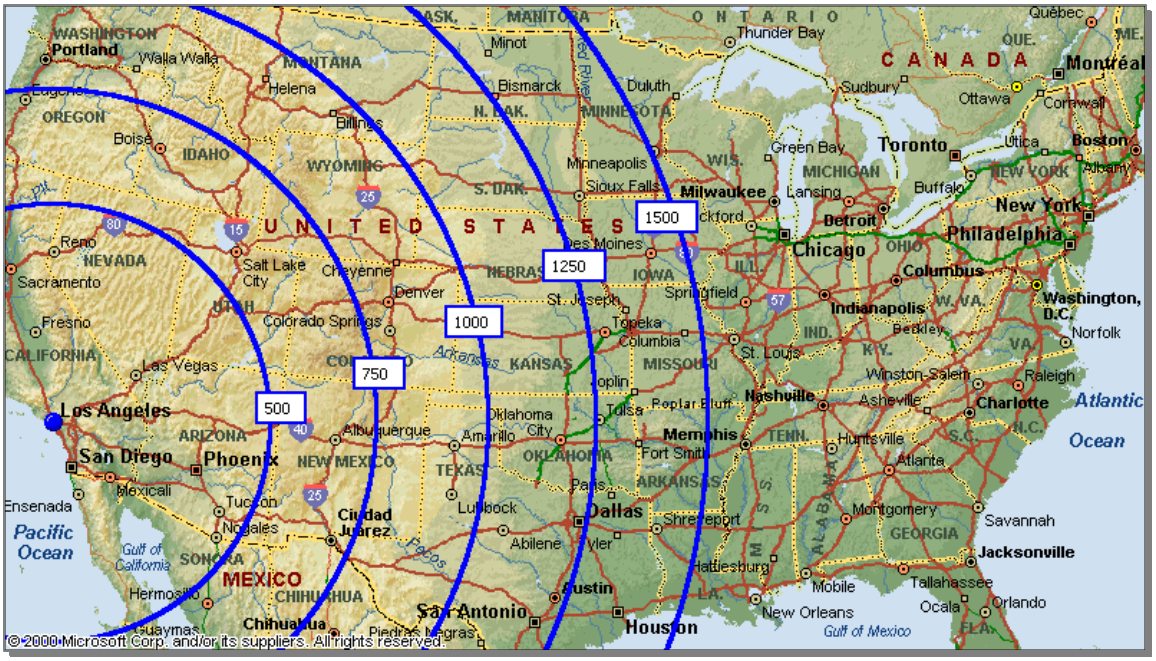
- consolidating the port rail operations of UP/SP and BNSF on a single line;
- improving intermodal rail efficiency compared to other modes; and
- facilitating the growth of on-dock transfer of containers between marine and rail modes.

Rail Carload Service

Rail *carload* customers are typically moving low value, bulk commodities. Most carload service consists of individual freight cars moved together in trains between major markets. These are the common freight trains whose consist of cars is mixed in both type and commodity and changes from day to day. Rail *unit trains* are the most economical form of carload service. Unit trains handle a large number of railcars moving between a specific origin and destination on a repetitive round-trip basis (e.g., coal moving from a mine to a power generating plant in a 100-car train, or grain moving from country to terminal grain elevators).

The pattern of rail carload traffic to and from the greater Los Angeles area is determined primarily by inalterable facts of geography (Exhibit 10.

Exhibit 10: Rail Market Geography



The major California, Nevada, and Arizona markets are within 250-500 miles (encompassing Bakersfield to Tucson). National markets begin at about 1200 miles (Portland and beyond).

There are no large markets between these two groups. A few smaller markets (Salt Lake City, El Paso, Albuquerque) are in the 700-900 mile range.

Most rail carload traffic originating in Southern California terminates in nearby states. Almost 60% stays in California. Nearly all Southern California rail carload tonnage is heavy bulk commodities, industrial products, or inputs to manufacturing. Most SCAG region carload traffic originates in a small number of scattered industrial districts.

Increased carload rail service would reduce congestion and emissions but has practical limits. Rail carload is already a low-cost mode for line-haul, but is most effective as a specialized service for appropriate commodities rather than an all-purpose mode.

- Local switching is costly, time-consuming, and has higher emissions than line-haul service.
- Access to direct carload service is a major barrier.
- Current logistics practices also limit the commercial application of carload service.

Carload Service Diversion Potential

Carload rail service (as opposed to intermodal service) is best suited to:

- bulk movements of raw materials (coal, grain, aggregates), or
- routine movement of industrial products (steel, chemicals, lumber).

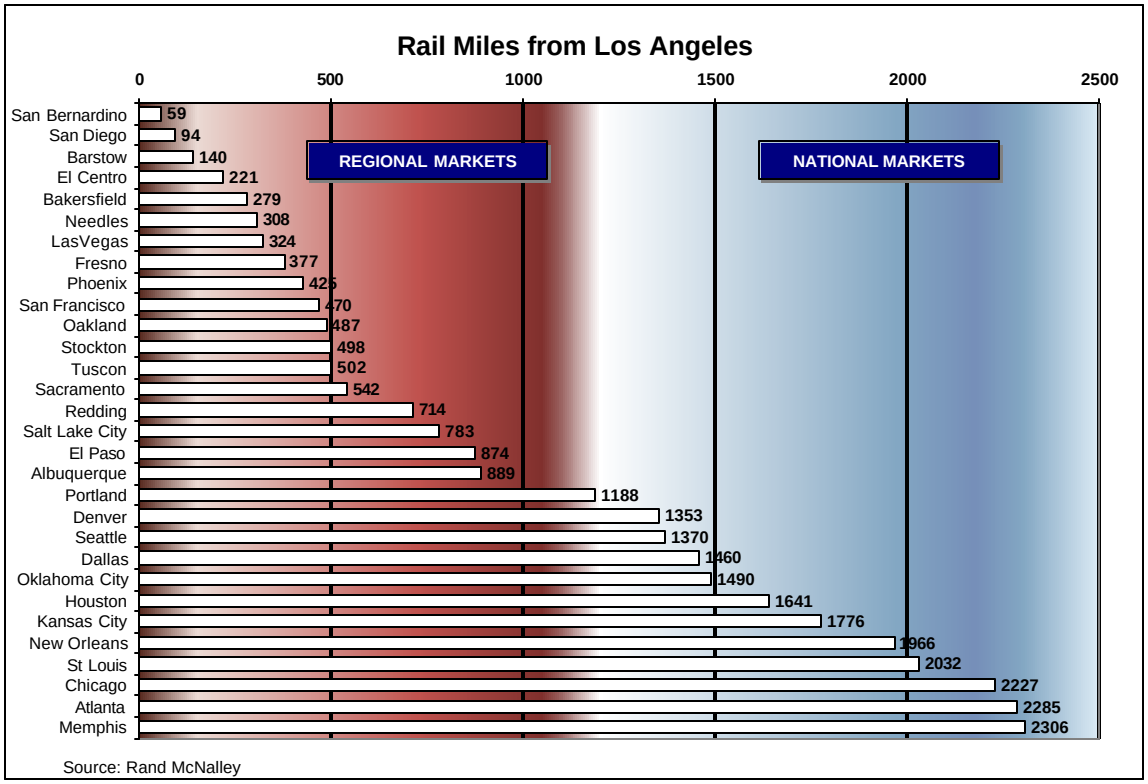
Direct carload service requires direct rail access, and is largely limited to major manufacturing and processing plants such as refineries, auto assembly plants, or power plants. Carload service, and unit train service in particular, will continue to grow with the customer base of heavy industrial activity, but is unlikely to attract new customers unless new plants are built with rail access. The potential for diversion of truckload traffic to direct carload service is therefore very limited, and rests with the initiatives of the railroads and their customers.

Short-Haul And Short-Line Carload Diversion Potential

Well-designed short-haul rail moves can serve niche markets, especially where they can either justify a new train move or add incremental traffic to an existing train.

- There are already many rail movements within California.
- The 500-1000 mile trip range, however, does not include large new freight markets outside California (Exhibit 11).
- Typical short-haul rail carload movements include regional transfers of bulk materials (e.g. sand and gravel, chemicals), and inter-plant moves as part of a production process.

Exhibit 11: Rail Miles From Los Angeles



There are three major barriers to expanded short-haul carload service.

- Local switching moves are relatively costly, especially for large, line-haul railroads with high labor costs. Such moves also generate significantly higher emissions than line-haul rail trips.

- Neither the revenue and profit potential for the railroad nor the cost savings potential for the customer are likely to justify the high cost of new trackage where rail sidings do not already exist.

- The lower revenue and profit potential of short-haul movements also make it difficult for line-haul railroads to devote scarce track capacity or operating "slots" to such traffic if longer-haul moves are available.

Short-haul diversion potential is also constrained by rail circuity. Rail routes to regional boundaries (cordon points) are significantly longer than highway routes in many instances. The largest potential short-haul market is between the SCAG Region and Northern California, along the I-5 corridor. The primary rail route to the north (paralleling Interstate 5) is through Cajon Pass, which is an average of 63 miles longer than the highway route to the regional boundary. The most important part of the SCAG region is Los Angeles County, for which the circuity adds over 100 miles on trips to Bakersfield and beyond. Since the distances to Northern California markets are typically 400-600 miles, the rail route is about 20% longer.

The lower-cost operations of short-line and switching railroads such as Pacific Harbor Line or the Ventura County Railway offer a solution to high switching costs, but also require additional interchange movements and revenue sharing. Rail-truck transloading offers a way around the access problem. The allocation of scarce track capacity is a tougher problem, and a major long-term public policy issue.

Short-haul rail service may be applicable to niche markets. The potential for short-line operations in the SCAG region could include:

- existing short line operations such as PHL, VCY, and Los Angeles Junction;
- a few existing branch lines, such as the San Jacinto Branch Line; or
- service to major new industrial parks and plants.

The long-term potential for greater short-line rail service in the SCAG region is limited.

- UP and BNSF have largely completed their branch line abandonment and rationalization programs, and there are few branch lines left that would be suitable for short-line operations.
- Railroad branch lines and secondary main lines are attractive candidates for high-priority rail passenger and commuter services such as Metrolink.

Rail Transloading

Rail transloading accomplishes one of the same goals as intermodal transportation: using both rail and truck modes to their best advantage. Transloading consists of transferring freight between rail cars (for the line haul) and trucks (for pickup or delivery). Commodities are diverse but have a common characteristic: the use of efficient handling equipment to transfer between rail and truck. The commodities generally unload from rail into either storage or onto a truck, but they can load from truck to railcar for outbound movement. The growth of transloading options and attendant logistics practices creates additional rail opportunities.

Truck-rail transloading has significant potential to increase the use of rail carload service for line-haul freight transportation.

- Truck-rail transloading offers the easiest access to rail carload service.
- Both major railroads see transloading as a business opportunity and a source of traffic growth. Sometimes railroads use transloading to compete with other railroads instead of competing with trucks.
- Short lines such as PHL have developed transloading programs and facilities to expand their market.

Transloading is not without its limitations, however:

- Transloading may be seen as an undesirable land use by local communities.

- Truck-rail transloading requires local/regional pick-up and delivery via truck, and is adversely affected by regional highway congestion.

- Truck-rail transloading would reduce long-haul truck traffic on major regional access routes, but would not reduce the number of local truck trips.

A recent private Southern California study ranked commodities as candidates for transloading. The criteria included revenue potential, employment potential, and environmental "friendliness." The top two commodity choices, consumer goods and foods and beverages, are not often transloaded without intermediate storage in distribution center inventory. Other candidates such as paper, building materials, and minerals are commonly transloaded in both private and commercial facilities.

The potential for conversion of truckload movements to rail carload service lies almost exclusively in transloading rather than direct carload access. It is estimated that rail/truck transloading could divert on the order of 132,000 annual long-haul trucks from regional highways and reduce truck VMT by over 23 million annually at year 2000 traffic levels. This finding is consistent with the commercial initiatives of both railroads, who have increased their transloading activity and marketing in recent years.

Transloading would have favorable impacts on truck VMT and emissions.

- Since transloading converts multiple truckloads in to a smaller number of rail carloads, the impact on VMT and emissions is potentially greater.

- Transloading is best conducted through numerous local and regional sites, and does not exhibit the same economies of scale and service that require large regional intermodal terminals. The requirement for local pick-up and delivery truck trips and VMT could therefore be lower.

Since the industrial products typically transloaded are less time-sensitive than intermodal shipments, railroads have additional flexibility in using their line capacity and operating windows.

Intermodal Freight Transportation

Intermodal is an attempt to combine the best features of multiple modes, using rail for the line-haul and truck for the pickup and delivery. The basic intermodal units are either trailers or containers moving inland by rail. The key feature of traditional intermodal moves in trailers or containers is that the unit stays sealed from door to door. "Intermodal" is sometimes used to describe passenger movements by multiple modes, but as used in this report refers exclusively to freight.

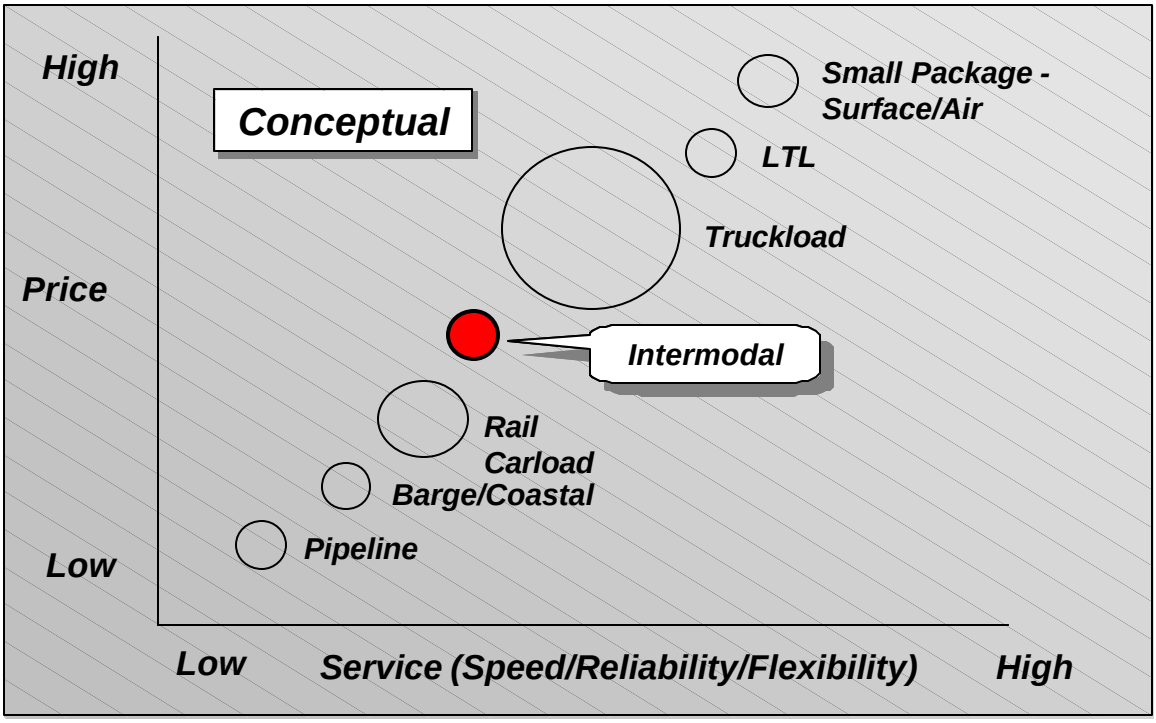
The Los Angeles area is a major market for domestic intermodal freight transportation. About a third of total U.S. rail intermodal traffic originates or terminates in the Los Angeles area. Of that volume roughly a third is domestic.

Intermodal transportation has significant potential to mitigate congestion on major interregional access routes.

- Rail-truck intermodal service offers the easiest transition from over-the-highway truck transportation.
- Major truckload, less-than-truckload, and parcel motor carriers already use intermodal service and see it as a growth area.
- The SCAG region has excellent intermodal service with adequate near-term capacity.

Intermodal fills a price/service gap between rail carload and truckload transportation (Exhibit 12).

Exhibit 12: Intermodal Service Comparison



Rail intermodal service requires economical trucking (drayage) to a nearby rail intermodal terminal. Terminal and drayage costs are intermodal overhead that must be offset by a long, efficient line-haul trip to be time and cost competitive with over-the-road trucking.

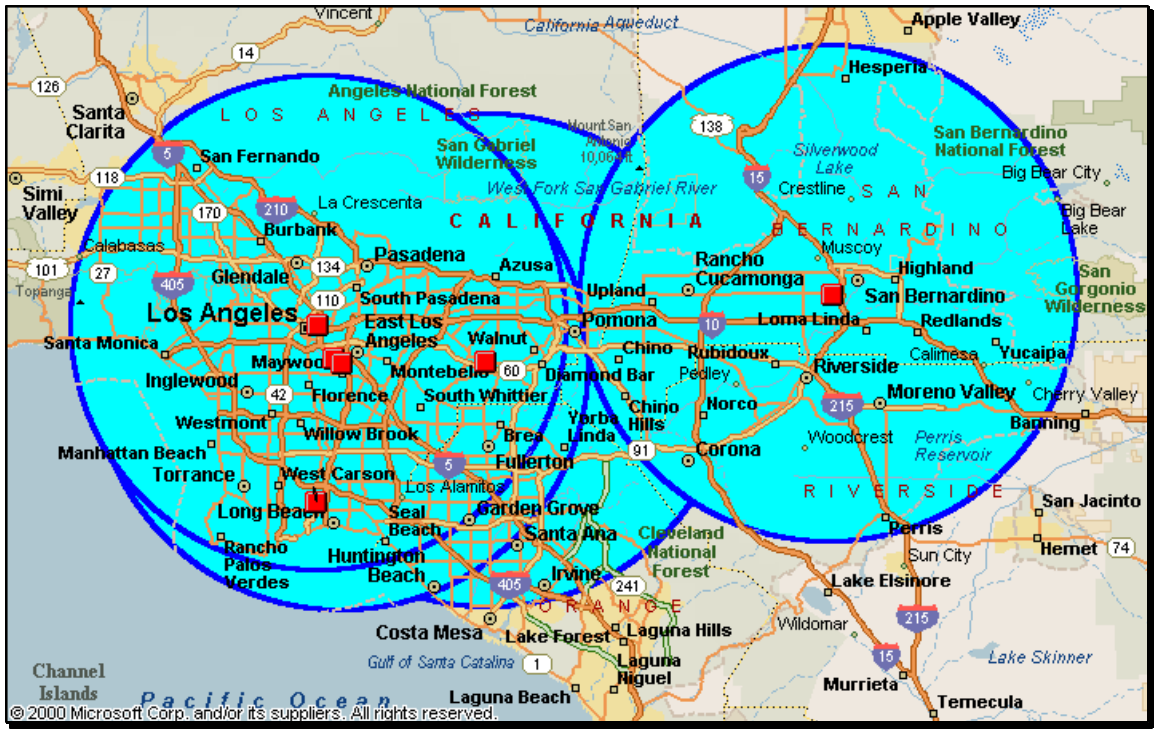
- Drayage typically costs $50 to $250 on each end of the movement, or $100 to $500 in total.
- Terminal costs are typically $30 to $50 at each end, or $60 to $100 per move.
- Drayage and terminal handling add 8-24 hours of time compared to highway truckload service.

Intermodal terminals (sometimes still called "piggyback ramps") transfer trailers and containers between trains and trucks. The SCAG region is served by the second largest intermodal rail complex in North America. Exhibit 13 shows the locations of rail intermodal facilities in the study region.

Exhibit 13: Intermodal Facility Locations

Typical intermodal drayage movements cover a 25-mile radius around the intermodal terminal. As shown in Exhibit 14, this intermodal reach covers most of the SCAG region around the terminals.

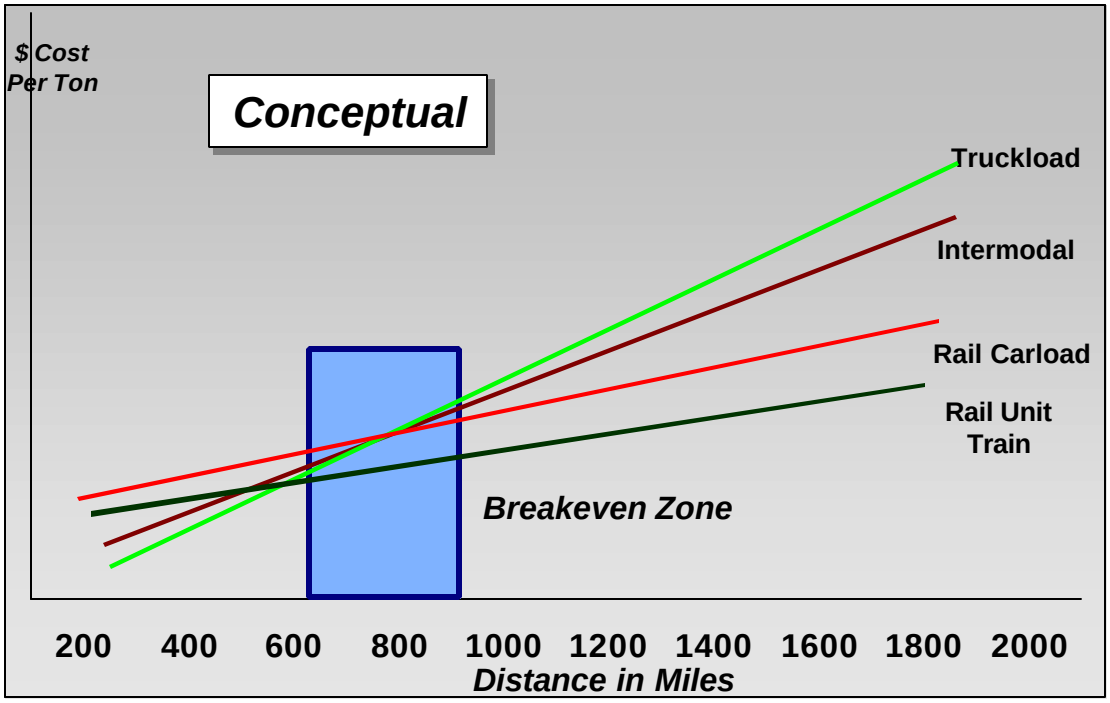
Exhibit 14: Intermodal Facility Coverage



Los Angeles area rail intermodal terminals originate and receive over 250 intermodal trains every week supporting the region's congestion management goals and environmental policy. Together, these rail intermodal terminals handled approximately 3 million trailers and containers in 1998.

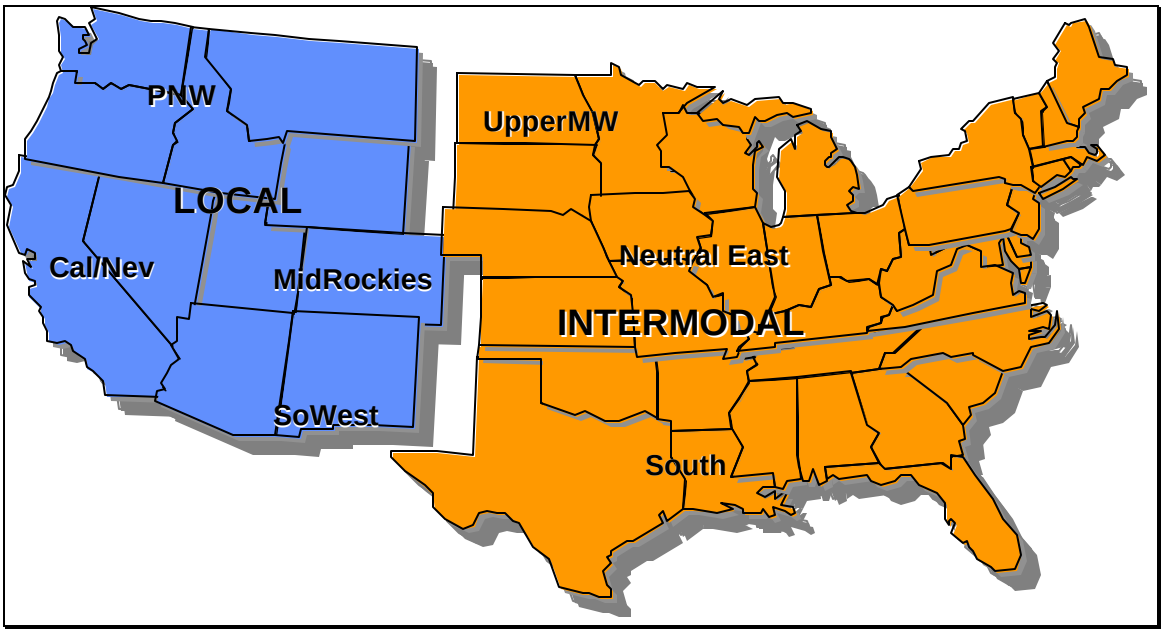
In order to be cost competitive, intermodal needs a long length of haul at low rail linehaul costs to spread or amortize those local trucking and terminal costs. The result is a strong competitive position over about 1000 miles and real cost advantages as the distance grows (Exhibit 15). Intermodal has very little presence in lanes of less than 750 miles, and almost none under 500 miles. If it is managed effectively, intermodal transportation can be successful at distances of under 300 miles.

Exhibit 15: Intermodal "Breakeven" Zone



From Southern California, intermodal service is typically competitive for traffic moving to or from points east of the Rockies (Exhibit 16). The busiest intermodal lane is between Los Angeles and Chicago, about 1800 miles. Reducing the "breakeven" distance from Southern California does not gain access to any large new markets, but could be the key to diversion of traffic between Northern and Southern California along I-5.

Exhibit 16: Local vs. Intermodal Markets



Rail Intermodal Diversion Potential

Diversion of long-haul truckload and LTL traffic to rail intermodal service could divert on the order of 107,000 annual trucks and over 13 million VMT annually from regional highways at year 2000 traffic levels.

The long-haul corridors linking the SCAG region with the rest of the nation are already among the most successful and busiest intermodal routes, with higher intermodal market shares than the national average.

- The SCAG region already has some of the nation's busiest intermodal facilities. The expected growth in rail intermodal traffic generated at San Pedro Bay ports will tax both intermodal terminals and line-haul capacity on both railroads.
- Both railroads, and their predecessors, have encouraged diversion of Southern California truck traffic to intermodal. There is a significant history of marketing and service initiatives aimed at increasing intermodal market shares in Southern California.
- Truckload and LTL motor carriers already use intermodal transportation to an appreciable extent to serve Southern California.
- Given the large expected increase in high-revenue, long-haul international intermodal traffic (imports and exports), railroads will be disinclined to dedicate or add capacity for low-revenue, short-haul intermodal business.

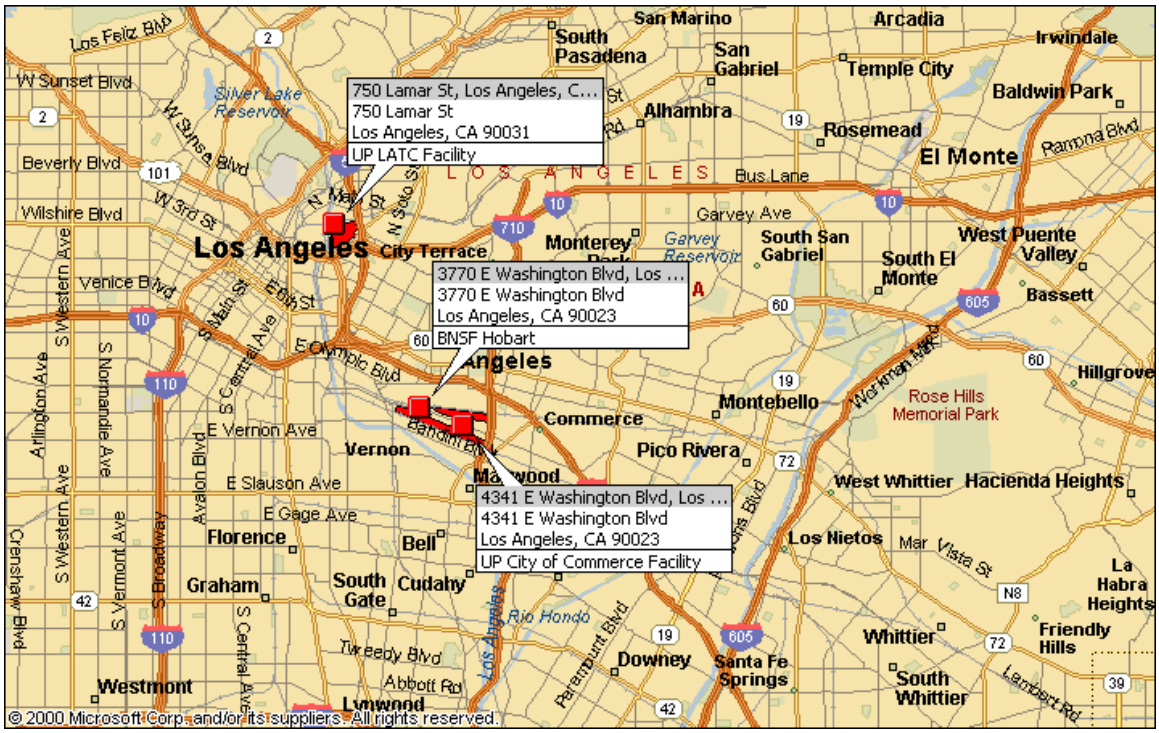
While both railroads continue to pursue greater domestic intermodal market share, it would be overly optimistic to expect dramatic increases. Intermodal service requires local/regional pick-up

and delivery via truck (drayage), and is thus adversely affected by regional highway congestion. Diversion of freight to intermodal service would reduce long-haul truck traffic on major regional access routes, but would not reduce local trips.

Congestion Implications for Intermodal Transportation

Intermodal transportation requires drayage for pick-up and delivery. Where drayage moves travel the same urban freeways as the truck trips they might replace, there is little net saving in either truck trips or emissions. The major Los Angeles intermodal facilities are centrally located, as shown in Exhibit 17. While this maximizes their market coverage and concentrates traffic volume, it also requires drayage trips over some of the most congested regional routes.

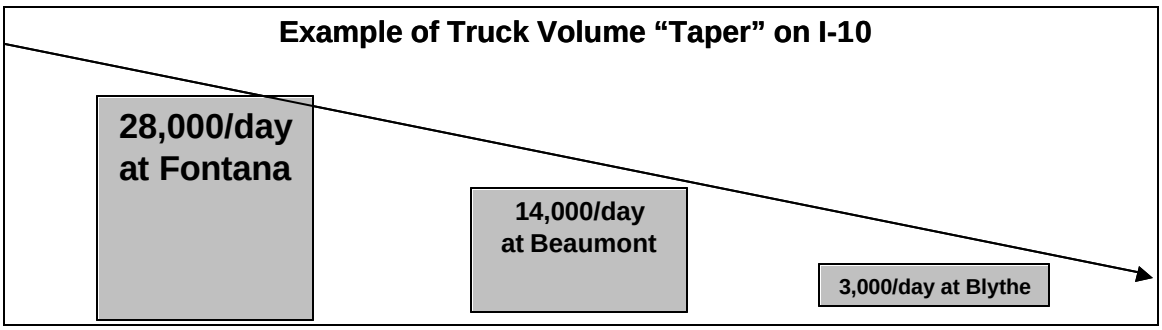
Exhibit 17: Central Intermodal Terminal Locations



Creating a series of intermodal facilities in outlying areas might disperse and shorten the drayage trips. The current BNSF and proposed UP facilities in the Inland Empire are examples. A balance must be struck, however, between the advantages of dispersed intermodal terminals and the need to assemble sufficient volume for frequent service.

The "congestion taper" limits the benefits of intermodal diversions. Truck and auto traffic volumes on regional highways are heaviest near the regions center and "taper" towards the edges, as illustrated in Exhibit 18.

Exhibit 18: Truck Congestion Taper



The majority of the truck VMT saved through diversion to intermodal would be in the outlying areas, since the intermodal option still requires drayage in the central regions.

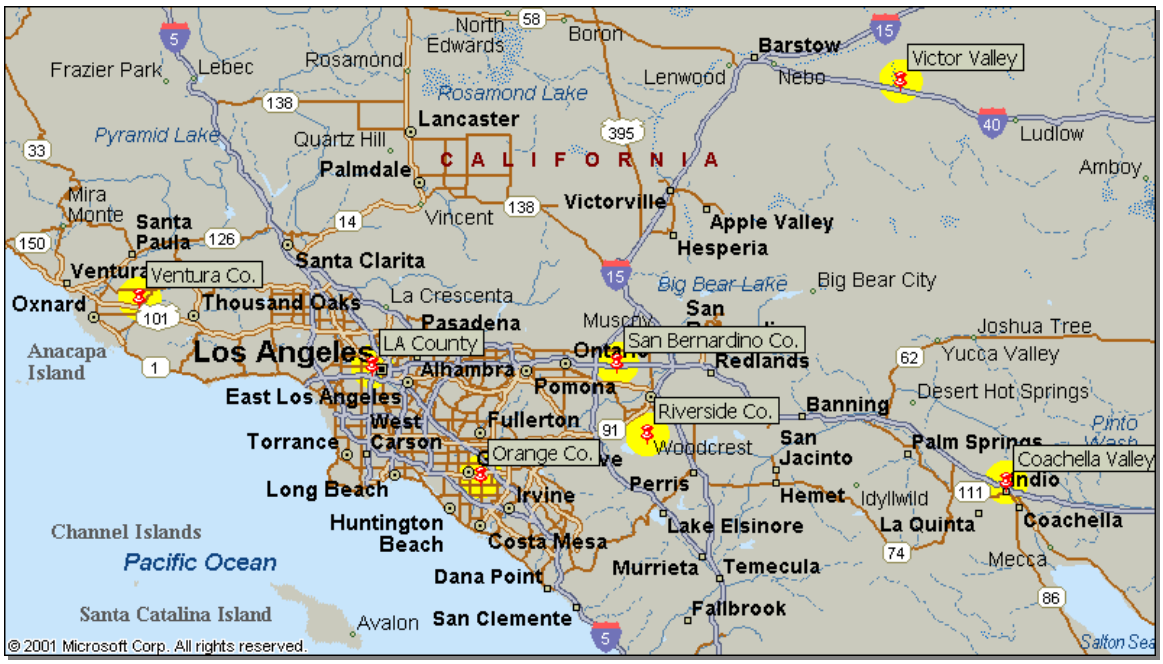
Potential Modal Diversions

Diversion estimates were based on length of haul and commodity modal shares. Existing modal shares were used to gauge the probability of diversion in each mileage block.

Length of haul

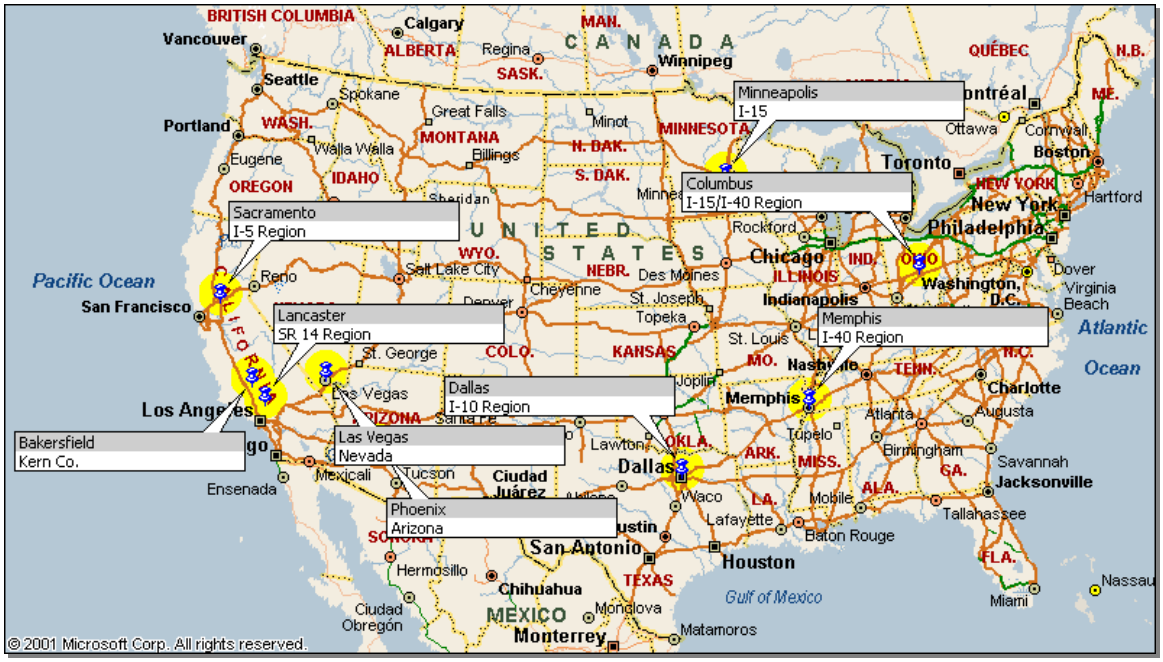
A truck mileage matrix was developed for internal and external trip "centroids". Survey data on intermodal preferences were used to assign divertability indices to distance categories. Length of haul and commodity indices were combined to estimate diversion percentages by regional pair, commodity, and mode. Truck mileage distance for each diverted trip was estimated as the distance from the centroid of each internal region to each external cordon. Employment centroids (Exhibit 19), rather than geographic centroids, were used to better estimate distances from truck-generating activities.

Exhibit 19: Internal Trip Centroids



External regions were assigned representative city "centroids", shown in Exhibit 20.

Exhibit 20: External Trip Centroids



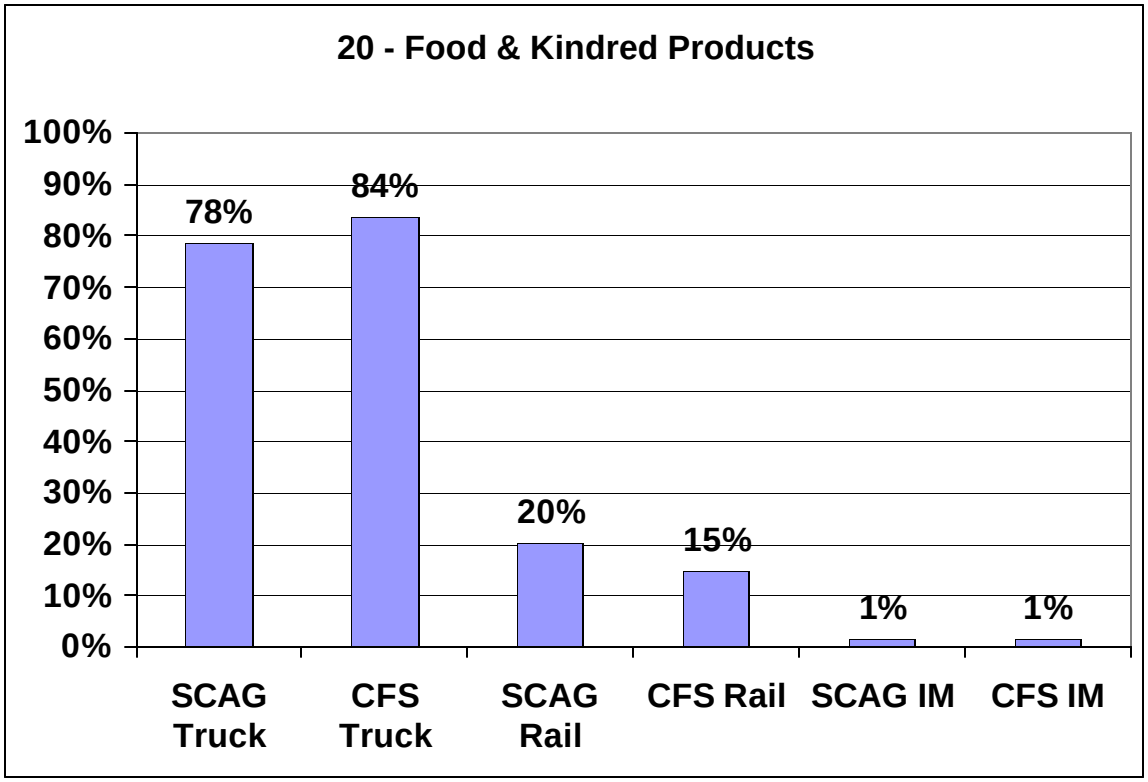
Average distances from rail facilities to cordons were also calculated for each internal region. Distances were based on existing nearby rail facilities for each internal region. Mileages and driving times were estimated for each combination.

Previous study results were used to create a divertability index by mileage block. Intermodal "users" rated intermodal service higher than non-users in each mileage block. Intermodal users also gave higher market shares to intermodal than the overall average.

Commodity modal shares

Major heavy-duty truck (HDT) commodities were identified, and US and SCAG region modal shares were compared to create indices for rail and intermodal shares. A sample of the modal shares is shown in Exhibit 21. The 19 major HDT commodities over 500,000 tons each were assessed for rail and intermodal divertability. In the absence of the vast resources necessary to examine even a majority of the individual flows, and acknowledging the fragmentary nature of the available data, the study team constructed a series of divertability indexes as proxies. A comparison of Commodity Flow Survey (CFS) national modal shares and estimated SCAG modal shares was used as a divertability index.

Exhibit 21: Example of Modal Commodity Shares



- Where national (CFS) rail or intermodal shares were higher than SCAG region shares, it was assumed – other things being equal – that there existed the potential for further diversions of SCAG region flows.

- Where national rail or intermodal shares were lower, it was assumed – other things being equal – that the potential for further diversions in the SCAG region was small.

Separate indexes were compiled for:

- Truckload to intermodal;
- LTL to intermodal; and
- TL to rail/transload.

The commodity-specific indexes were combined with the mileage-based indexes to yield a consolidated index of divertability that roughly reflected both commodity and geographic variables.

Year 2000 Annual Intermodal Diversion Estimates

The study team developed an order-of-magnitude estimate for the potential year 2000 diversion from trucks to intermodal transportation (Exhibit 22) using the methodology described earlier. The potential diversion could be on the order of 1.6 million annual tons, the equivalent of roughly 72,000 annual truckloads.

The largest potential diversions were found in the I-5 corridor, which is by far the most heavily traveled truck route. Realizing these potential diversions would require successful intermodal service to Northern California – a relatively short haul – and to the Pacific Northwest.

Exhibit 22: Intermodal Diversion Estimates

	Annual Tons Diverted by Cordon Point					
SCAG Region	**I-5 North**	**SR14**	**I-15 North**	**I-10**	**I-40**	**Totals**
Los Angeles Co.	539,956	1,620	254,399	99,115	38,760	**933,850**
Orange Co.	272,211	643	67,028	22,959	8,306	**371,146**
Ventura Co.	26,790	36	11,426	7,295	1,749	**47,296**
Riverside Co.	68,769	127	16,984	7,501	2,961	**96,343**
San Bernardino Co.	56,334	119	20,794	12,500	3,116	**92,863**
Victor Valley	22,983	24	8,624	4,375	1,204	**37,211**
Coachella Valley	13,012	147	13,574	3,168	1,165	**31,066**
Total	**1,000,056**	**2,717**	**392,829**	**156,913**	**57,260**	**1,609,774**

	Annual Trucks Diverted by Cordon Point					
SCAG Region	**I-5 North**	**SR14**	**I-15 North**	**I-10**	**I-40**	**Totals**
Los Angeles Co.	24,201	61	11,846	4,491	1,905	**42,503**
Orange Co.	10,765	23	3,245	1,145	419	**15,597**
Ventura Co.	1,156	1	545	370	84	**2,156**
Riverside Co.	3,255	5	840	375	153	**4,629**
San Bernardino Co.	2,433	4	994	573	157	**4,162**
Victor Valley	988	1	405	199	59	**1,651**
Coachella Valley	607	5	628	150	51	**1,441**
Total	**43,406**	**100**	**18,501**	**7,303**	**2,828**	**72,139**

The potential intermodal diversions would be the rough equivalent of 230 trucks per day, more than half of which would come from Interstate 5. While this sounds like a significant body of traffic, in fact the reduction in truck traffic on major freeways would be relatively small.

Year 2000 Annual Rail Transload Diversion Estimates

The study team estimated potential rail carload diversions through transloading (Exhibit 23) at almost 2 million tons annually, or the equivalent of almost 90,000 truckloads. Again, the largest diversions would come in the I-5 corridor, where UP and its predecessor SP have both undertaken carload service initiatives designed to encourage such diversions. The estimated, order-of-magnitude rail/transload diversions would be the equivalent of about 287 daily trucks.

Exhibit 23: Rail Transload Diversion Estimates

	Annual Tons Diverted by Cordon Point					
SCAG Region	**I-5 North**	**SR14**	**I-15 North**	**I-10**	**I-40**	**Totals**
Los Angeles Co.	474,183	265	214,248	424,797	61,829	**1,175,322**
Orange Co.	207,887	91	47,217	84,067	17,701	**356,962**
Ventura Co.	29,523	6	11,867	41,633	2,316	**85,345**
Riverside Co.	72,539	22	18,961	33,362	4,415	**129,299**
San Bernardino Co.	61,160	21	20,368	57,365	4,538	**143,451**
Victor Valley	21,057	3	7,938	20,455	1,838	**51,292**
Coachella Valley	13,569	24	8,915	14,921	1,677	**39,107**
Total	**879,918**	**432**	**329,513**	**676,600**	**94,314**	**1,980,778**

	Annual Trucks Diverted by Cordon Point					
SCAG Region	**I-5 North**	**SR14**	**I-15 North**	**I-10**	**I-40**	**Totals**
Los Angeles Co.	21,424	10	9,968	19,054	2,948	**53,403**
Orange Co.	8,344	3	2,233	3,841	854	**15,276**
Ventura Co.	1,293	0	575	2,101	112	**4,081**
Riverside Co.	3,559	1	944	1,565	226	**6,295**
San Bernardino Co.	2,741	1	967	2,606	224	**6,538**
Victor Valley	941	0	376	934	91	**2,341**
Coachella Valley	655	1	413	689	75	**1,833**
Total	**38,956**	**16**	**15,476**	**30,789**	**4,530**	**89,767**

Year 2000 Annual Combined Diversion Estimates

The combined intermodal and rail transload diversions (Exhibit 24) could reach roughly 3.6 million tons at year 2000 traffic levels, or the annual equivalent of about 162,000 trucks.

Exhibit 24: Combined Diversion Estimates

SCAG Region	Annual Tons Diverted by Cordon Point					
	I-5 North	SR14	I-15 North	I-10	I-40	Totals
Los Angeles Co.	1,014,139	1,885	468,647	523,912	100,589	**2,109,173**
Orange Co.	480,097	734	114,244	107,026	26,007	**728,108**
Ventura Co.	56,313	42	23,293	48,928	4,064	**132,641**
Riverside Co.	141,308	149	35,945	40,863	7,376	**225,641**
San Bernardino Co.	117,494	140	41,162	69,865	7,653	**236,314**
Victor Valley	44,041	27	16,562	24,830	3,042	**88,502**
Coachella Valley	26,581	171	22,489	18,089	2,842	**70,173**
Total	**1,879,974**	**3,149**	**722,342**	**833,513**	**151,574**	**3,590,552**

SCAG Region	Annual Trucks Diverted by Cordon Point					
	I-5 North	SR14	I-15 North	I-10	I-40	Totals
Los Angeles Co.	45,624	71	21,814	23,545	4,853	**95,907**
Orange Co.	19,109	27	5,478	4,986	1,273	**30,873**
Ventura Co.	2,448	2	1,120	2,471	196	**6,237**
Riverside Co.	6,814	6	1,784	1,940	379	**10,923**
San Bernardino Co.	5,174	5	1,960	3,179	382	**10,700**
Victor Valley	1,929	1	780	1,133	149	**3,993**
Coachella Valley	1,262	6	1,041	839	126	**3,274**
Total	**82,362**	**117**	**33,977**	**38,092**	**7,358**	**161,906**

VMT and Emissions Impacts

Methodology

The diverted truck VMT and added ton-miles for rail and intermodal shipments were used to estimate changes in vehicle emissions and fuel consumption. Distances were checked for all the combinations of SCAG region centroid and regional cordon point for both truck (freeway) and rail routes. As shown in Exhibit 25, virtually all the rail distances are longer than the truck distances. (The exceptions are mostly due to UP's Saugus line, which is little used and would carry few diverted moves.)

Exhibit 25: Cordon Point Distances

Truck and Rail Cordon Point Distances (Miles)										
	I-5 North		SR14		I-15 North		I-10		I-40	
	Truck	Rail	Truck	Rail	Truck	Rail	Truck	Rail	Truck	Rail
Los Angeles Co.	71	196	81	78	243	283	253	247	273	255
Ventura Co.	75	272	95	96	278	360	299	324	322	331
Riverside Co.	129	149	107	145	204	236	201	200	249	208
Orange Co.	107	228	118	110	227	315	248	279	272	287
San Bernardino Co.	115	138	92	86	194	225	200	189	238	197
Victor Valley	103	99	107	153	103	159	224	293	127	149
Coachella Valley	254	215	157	163	254	302	125	112	201	274

The difference is most apparent in the Los Angeles/I-5 North combination, which also accounts for the largest single body of diverted traffic. There, the railroads must take 196-mile (average)

routes out through San Bernardino and Cajon Pass to reach a common point at Mojave, while trucks climb I-5 over Tejon Pass to reach Gorman in just 71 miles.

The longer rail routes require more ton-miles to achieve the same transportation purpose, and raise the rail and intermodal emissions estimates accordingly. For example, a San Bernardino Co. to I-10 Region transloading diversion to rail would save 189 truck miles but incur 200 rail miles, a net increase in ton-miles. This increase must be offset by significantly lower units emissions from rail service. Most of the truck VMT saved would be on the less congested portions of I-10 to the east.

Rail Transloading VMT Impacts

VMT reductions were estimated for each combination of SCAG region segment and external region (Exhibit 26). Each mileage calculation extended only to the regional cordon point.

Exhibit 26: Rail Transloading VMT Impacts

	Annual Truck VMT Reduction by Cordon Point					
SCAG Region	**I-5 North**	**SR14**	**I-15 North**	**I-10**	**I-40**	**Totals**
Los Angeles Co.	2,244,465	1,432	3,470,820	7,164,909	1,125,296	**14,006,923**
Orange Co.	1,482,926	711	714,545	1,389,908	320,978	**3,909,069**
Ventura Co.	147,617	39	219,931	829,882	49,713	**1,247,181**
Riverside Co.	623,832	156	257,870	447,056	73,282	**1,402,196**
San Bernardino Co.	468,892	127	263,428	764,866	71,999	**1,569,312**
Victor Valley	210,013	23	54,399	305,327	15,538	**585,300**
Coachella Valley	171,788	251	150,961	124,343	22,474	**469,817**
Total	**5,349,534**	**2,740**	**5,131,954**	**11,026,290**	**1,679,280**	**23,189,798**

Since the high-volume I-5 corridor also has a shorter cordon distance (e.g. 71 miles from LA Co.) than the I-15, I-10, or I-40 corridors (ranging from 243 to 273 miles from LA Co.), the VMT estimates are not as heavily weighted toward I-5 as the truck counts or tonnage estimates.

Intermodal VMT Impacts

The intermodal VMT impacts (Exhibit 27) were adjusted for drayage requirements.

Exhibit 27: Intermodal VMT Impacts

	Annual Net* Truck VMT Reduction by Cordon Point					
SCAG Region	**I-5 North**	**SR14**	**I-15 North**	**I-10**	**I-40**	**Totals**
Los Angeles Co.	1,979,840	7,031	3,849,902	1,566,018	664,086	**8,066,877**
Orange Co.	1,446,346	3,865	892,360	337,802	135,498	**2,815,871**
Ventura Co.	20,717	77	163,472	114,586	30,147	**329,000**
Riverside Co.	481,385	702	203,803	88,511	44,420	**818,821**
San Bernardino Co.	394,339	656	249,525	147,499	46,736	**838,755**
Victor Valley	194,746	135	46,168	58,737	8,373	**308,159**
Coachella Valley	101,494	830	163,886	11,004	9,945	**287,159**
Total	**4,618,867**	**13,296**	**5,569,118**	**2,324,158**	**939,205**	**13,464,643**

* Adjusted for drayage requirements

Combined VMT Impacts

The combined rail transloading/carload and intermodal VMT impacts are shown in Exhibit 28.

Exhibit 28: Combined VMT Impacts

SCAG Region	Annual Net* Truck VMT Reduction by Cordon Point I-5 North	SR14	I-15 North	I-10	I-40	Totals
Los Angeles Co.	4,224,306	8,463	7,320,723	8,730,928	1,789,382	**22,073,800**
Orange Co.	2,929,272	4,576	1,606,906	1,727,710	456,476	**6,724,940**
Ventura Co.	168,335	116	383,403	944,468	79,860	**1,576,181**
Riverside Co.	1,105,217	858	461,674	535,566	117,702	**2,221,017**
San Bernardino Co.	863,231	783	512,953	912,366	118,735	**2,408,067**
Victor Valley	404,759	158	100,567	364,063	23,911	**893,459**
Coachella Valley	273,281	1,081	314,847	135,347	32,420	**756,976**
Total	**9,968,401**	**16,036**	**10,701,072**	**13,350,448**	**2,618,485**	**36,654,441**

* Adjusted for drayage requirements

Combined Emissions Impacts

The combined rail carload and intermodal diversion VMT and ton-mile changes were used to estimate the net change in comparable emissions factors. Note that not all of the factors listed could be estimated for both modes from the available literature.

- Over-the-road (OTR) truck emissions vary with driving conditions.
- Line-haul rail emissions are generally much lower than OTR truck, but intermodal NOx emissions are higher.
- The longer rail hauls noted earlier reduce rail's emissions advantage.

Exhibit 29: Combined Emissions Impacts

	1999/2000 Emissions Impacts Truck Reduction	Drayage Increase	Rail IM Increase	Rail Carload Increase	Net Change
ROG	93,702	4,930	na	na	na
CO	434,817	22,875	77,892	71,756	**(262,294)**
NOx	1,496,531	78,731	1,058,154	994,058	**634,412**
CO2	169,567	8,921	na	na	na
PM10/PM	64,529	3,395	27,189	25,832	**(8,113)**
HC	na	na	30,128	28,702	na

The factors located and used for this study, when applied to the diversion estimates, indicate a net decrease in CO and PM10/PM emissions, but higher NOx emissions.